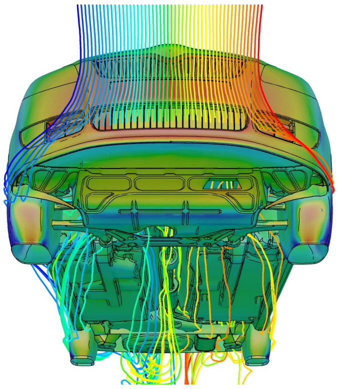
SUSTAINABLE DEVELOPMENT

Aerodynamics Solves Noise And Vehicle Soiling

Although people always wanted to fly and one day the Wright brothers found the way, aerodynamics experts working in the automotive industry do their best to prevent vehicles from flying and, instead, keep them on the road under all circumstances. That, however, is not all they do.

The responsibility for aerodynamics at Škoda Auto lies with the Pre-Development Department in Česana. "These days we have much more advanced and efficient tools than the Wright brothers or the Boleslav-based aeronaut Metoděj Vlach ever had," says aerodynamics specialist Jan Jagrik from the Pre-Development Department. "Using state-of-the-art systems and methods, we reduce the aerodynamic drag and lift of newly developed vehicles to reduce fuel consumption and pollutant emissions, as well as to improve key vehicle handling characteristics. One of the reasons why reducing aerodynamic drag is necessary is that vehicles are constantly getting larger. Consumers require more and more comfort, increasingly bigger inside space, stricter safety regulations and increasingly bigger deformation zones around the entire passenger compartment. As a result, vehicles' frontal areas are growing, too, and it's therefore necessary to compensate for this growth by reducing the aerodynamic drag coefficients to achieve acceptable vehicle handing characteristics."



In past, air flow in wind tunnels would be visualized using cotton fibres sticked onto the surface of the model. Nowadays, smoke probes or other advanced methods are used, such as PIV (Particle Image Velocimetry) or the ever more frequent VFD (Virtual Fluid Dynamics) computer simulations, visualizing the air flow in virtual reality.

Aerodynamic lift and its proper front-and-rear-axle distribution is one of the key aspects in terms of on-road stability. In particular, the driver will appreciate safe maneuverability in sudden gusts of side wind, as the vehicle remains steady in the driving direction and does not require any corrections with the steering wheel. On the other hand, an unsteady vehicle forces the driver to correct the direction by turning the steering wheel and sometimes also slow down. "Aerodynamics are measured in an aerodynamic wind tunnel, a huge building equipped with a ventilator whose absorbed power is similar to that of a small power plant produces. The ventilator sets a mass of air in motion, giving it required speeds and directing it against the tested vehicle that stands on aerodynamic scales," explains Jan Jagrik. "The scales measure aerodynamic forces and torques that are then used by our specialists and designers in shaping new vehicles to make them both efficient and good-looking. As the operation of the aerodynamic wind tunnel is very expensive, every measurement is prepared very carefully and with a high degree of detail."

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It is not only the operation of the aerodynamic wind tunnel that is really expensive – the construction is very expensive, too. That is why no full-scale wind tunnel (making it possible to perform full-scale measurement of real vehicles) has been built so far in the Czech Republic and why Škoda Auto performs real-vehicle measurements in the VW Group's wind tunnels in Wolfsburg and Ingolstadt. However, the initial vehicle designs are not full-scale, the usually applied scale is smaller (e.g., 1:4). Measurements using precise clay-surface models that can be modified very quickly and easily are performed in Prague -Letňany, in a wind tunnel of the Aeronautical Research and Test Institute (VZLÚ).

Advanced computer simulation tools known as CFD (Computational Fluid Dynamics) have been employed in automotive aerodynamic development over the past few years. CFD simulations do not require real vehicles, CAD models are enough. These days extensive virtual simulations are performed on tens of computer processors even before the first prototypes are produced. “CFD codes provide our specialists with numerous possibilities of making the air-flow along and inside vehicles visible in any views and with any degree of detail,“ says Jagrik. “Nonetheless, our experts explore much more than just air-flow along the body, they need to look at other parts of the vehicles, too. For example, all plastic covers under the floor play a major role in guiding the air in the gap between the vehicle and the road, helping to reduce aerodynamic drag and lift. Our developers spend many hours on guding the air under the bonnet, because the current engines and transmission systems require efficient cooling and enough air for the intake tract to achieve maximum possible efficiency levels. Similarly, the brakes need enough cooling-air to work properly and avoid overheating that would endanger the driver,” explains the aerodynamics specialist. Vehicle soiling has been a big issue over the past few years. Using water jets, the efficiency of the windscreen wipers, the directions of water-flow over the A-pillar and subsequent soiling of the side windows and wing mirrors are tested routinely in aerodynamic wind tunnels. Also simulated is the way water is splashed off the wheels – the researchers explore the body parts spattered with water and look at what exactly the water does after impact on the body. Using special snow guns in wind tunnels cooled for this particular purpose, the researchers explore the ways snow falls onto the vehicle body and deposits in the engine compartment.

Besides body soiling, special aerodynamic wind tunnels can measure aeroacoustics, aerodynamic noise caused by turbulent flow and its interaction with the vehicle surface. As the noise produced by tyres and mechanical elements such as the engine and the transmission system is being reduced, it is becoming increasingly desirable to eliminate aerodynamic noise, particularly at higher speeds. Air-flow inside the passenger compartment are not neglected in the development stages, either – the responsibility for this particular area lies with the Body Design Department.

Automotive aerodynamics are an unpredictable discipline, because the same set of modifications work differently on each type of body and differences occur even between the respective engine varieties used in the same vehicle. “Some may find it paradoxical that a vehicle's drag is reduced as we add parts that are exposed to considerable drag forces,” says Jan Jagrik. “For example, if we install a spoiler under a vehicle's front bumper, the spoiler is subject to a considerable drag force. Yet the vehicle's overall aerodynamic drag decreases, because the spoiler has a positive impact upon the flow along the entire vehicle and also changes the air-flow parameters far behind the vehicle. Our specialists make use of such paradoxes fairly often.“

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